

**New Jersey Department of Environmental Protection**

**Bureau of Discharge Prevention**

**A Guide to the Inspection and Testing of Aboveground Storage Tanks**

Issued: July 1995

Revised: September 2001

**This document supersedes the September 1997 edition of AA Guide to Testing Aboveground Storage Tanks®.**

## Table of Contents

Introduction	2
Integrity Testing	4
Static Head Testing	5
Nondestructive Testing	5
Internal Visual Inspections	6
Options for Extending Internal Visual Inspections for Steel Tanks	6
Alternative Testing Methods	10
Fiberglass Reinforced (FRP) Tanks	10
Homogenous Plastic Tanks	10
Pressure Vessels	10
Shop Fabricated Tanks	11
Elevated Multi-compartment Tanks	11
Informational Resources	12

## Introduction

N.J.A.C. 7:1E et seq., the Discharge Prevention, Containment, and Countermeasure (DPCC) rules, specifies testing and inspection requirements for aboveground storage tanks over 2,000 gallons in capacity which contain hazardous substances identified pursuant to N.J.A.C. 7:1E-1.7. These standards apply to major facilities as defined at N.J.A.C. 7:1E-1.6.

N.J.A.C. 7:1E-2.2(a) requires that any such tank installed or placed into service on or after July 22, 1990, be subject to full integrity testing prior to being placed into service for hazardous substance storage. Any tank placed into service prior to this date which is now covered by N.J.A.C. 7:1E as a result of regulatory changes or as result of increased storage capacity must now undergo initial integrity testing or static head product testing immediately upon entering the DPCC program. Subsequent testing must include a combination of integrity testing **and** internal inspections and must be performed at intervals of no more than **five years**, unless the tank follows an inspection and maintenance program that is in compliance with American Petroleum Institute Standard 653 (API 653). In addition, all storage areas, including tanks with associated piping, must be visually inspected for integrity and signs of leakage pursuant to N.J.A.C. 7:1E-2.10(a). A qualified professional engineer or an appropriate API certified inspector should review the results of integrity tests and internal visual inspections to ensure the tank is fit for service. If integrity test or internal inspection results indicate significant deterioration of structural strength or other signs that the tank is not sound, the tank must either be repaired or removed from service.

**Again, it is emphasized that static head testing, non-destructive testing, and an internal visual inspection are required, as described above.**

**If an alternate method of integrity testing or internal inspection will be used for a particular tank under the provisions of N.J.A.C. 7:1E-1.11(e), this method must be clearly described in the facility's approved DPCC plan prior to implementation.**

AA Guide to the Inspection and Testing of Aboveground Storage Tanks® has been prepared to assist the regulated community in selecting a method of integrity testing and to establish alternatives to emptying and cleaning a tank every five years while still meeting the internal inspection requirement. This document is specifically intended for tanks that will be inspected at no more than five-year intervals. If the tank is in compliance with API 653, please see Bureau of Discharge Prevention (bureau) guidance document **AA Guide to the Implementation of API 653**® for more information regarding this standard. Mention of any trade name or commercial product in this document does not constitute an endorsement of the product by the bureau or the New Jersey Department of Environmental Protection (department).

Any questions regarding the inspection and testing of aboveground storage tanks may be directed to the Bureau of Discharge Prevention, NJDEP, PO Box 424, Trenton, NJ 08625-0424 or by telephone at (609) 633-0610.

# Integrity Testing

The purpose of integrity testing is to ascertain whether a tank is leaking or deteriorating, and if it is deteriorating, the remaining useful life of the tank. The integrity of a tank is evaluated by a combination of integrity testing and internal visual inspection. Integrity testing is defined at N.J.A.C. 7:1E-1.6 as “a method of testing structures where either hydrostatic testing using water or other liquid or pneumatic testing is done in combination with a system of nondestructive testing which includes shell thickness testing...” Therefore, a complete evaluation of the integrity of a tank consists of **3 parts**:

1. **Static head testing** using water or other liquid, or pneumatic testing to detect an active leak;
2. **Nondestructive testing**, which includes shell thickness testing. The nondestructive testing procedures shall be adequate to detect cracks, leaks, and corrosion, erosion or other wall thinning to less than a predetermined minimum thickness to ensure sufficient structural strength;
3. **Internal visual inspection** is an optical examination of the interior of a tank sufficient to detect corrosion or leaking of the tank bottom and to identify and evaluate any tank bottom settlement.

Depending on the test method selected, the tank may be in service or out of service at the time of the test. It is important to note that **all three components** must be completed in order to demonstrate compliance with N.J.A.C. 7:1E-2.2(a)4. Also, the time period between the combination of integrity testing (static head and nondestructive) and internal visual inspection shall not exceed **five (5) years**, except as discussed later.

### **Static Head Testing:**

The static head test has been the most widely used test for active leak detection. The standard static head test measures the stability of a volume of liquid in a tank filled to at least 75% capacity and held over a minimum period of 24 hours. If temperature fluctuations are likely to occur, as when a tank is outdoors, a volume correction factor is required to determine the standardized adjusted volume at 60 degrees Fahrenheit; the correction factor is calculated in accordance with the API Manual of Petroleum Measurement Standards. If the beginning and ending temperature-adjusted level readings are within 0.2% of each other and no abnormal conditions are observed, the tank has successfully passed the static head test. Modifications to this procedure may also be acceptable. Continuous under-tank leak detection systems, which have been previously reviewed by the bureau, may be used as an acceptable alternative to static head testing.

### **Nondestructive Testing:**

The nondestructive testing techniques currently known to the Department include ultrasonic thickness (UT), acoustic emission, magnetic particle, electromagnetic particle or eddy current, radiography and radiation, and liquid penetrant. The bureau will also consider new testing techniques on a case-by-case basis, as they become available. Integrity testing should be performed in compliance with accepted industry standards, including but not limited to, API 510, API 574, API 653, ASME Boiler and Pressure Vessel Code Sections V, VIII, and X, and ASTM E 1067. In addition, descriptions of the various testing methods, including their applications, advantages and disadvantages, are widely discussed in trade journals and engineering handbooks. See page 7 for recommendations on UT measurements.

Based on integrity test results reviewed by the bureau, it appears that ultrasonic thickness testing is the most widely used nondestructive test method used for steel tanks in complying with the nondestructive component of the integrity testing requirements.

### **Internal Visual Inspections:**

N.J.A.C. 7:1E-2.2(a)4 requires that storage tanks undergo internal visual inspections in combination with integrity testing. The purpose of this inspection is to ascertain the condition of the interior of a tank, especially the bottom. Emptying and cleaning a tank and then performing a direct examination of the tank interior will meet the internal inspection requirement. An internal visual inspection should be an optical examination of the interior of an aboveground storage tank sufficient to detect corrosion or leaking of the tank bottom and to identify and evaluate tank bottom settlement. The department highly recommends performing ultrasonic tests on the tank bottom when performing a direct internal inspection of steel tanks.

For financial, safety, and other factors, some tank owners have requested information on alternatives to physically entering a tank, which will be acceptable to the bureau.

### **Options for Extending Internal Visual Inspections for Steel Tanks:**

The bureau has identified three alternatives to emptying and cleaning a **steel tank** every five years when performing internal inspections. If one of these options is chosen, it must be approved by the bureau and clearly described in the facility's DPCC/DCR plan. Three (3) options for extending the internal visual inspection up to ten (10) years are as follows:

1. For elevated tanks, UT measurements around the entire tank at acceptable locations can

lengthen the interval between internal visual inspections up to ten (10) years.

- a. For elevated horizontal tanks, UT measurements must be made at equidistant locations of no more than one (1) foot spaced around the circumference of the tank and at least every 10 feet along the length of the tank, provided at least three (3) circumferential bands of UT measurements are taken. The tank ends must be sampled at one (1) foot intervals vertically along the diameter. See **Figure 1**.
- b. For elevated vertical tanks, the roof and bottom must be inspected at 1 foot intervals from the centerpoint radiating along lines 90 degrees apart and then at 1 foot intervals vertically along the shell. See **Figure 2**.

If this option is used, the tank must be emptied and cleaned for direct internal examination if the test results indicate significant wall thinning or corrosion but in no case shall the interval between direct internal examinations exceed once every ten years. Significant corrosion for a particular tank is dependent on the service, construction, and environment of the tank and needs to be determined using accepted industry practice and best engineering judgement. If the tank has not undergone a direct internal inspection within the last 10 years, this option may only be used with prior written approval from the department. This option is not acceptable for double walled tanks.

2. If the tank bottom is not accessible from the outside, UT measurements may be made on the tank roof and shell as described in option 1b and around the circumference of the tank no more than six inches from the base of the tank (chime area). The condition of the tank bottom can be determined with acoustic emission testing. See **Figure 3**.



If this option is used, the tank must be emptied and cleaned for direct internal examination if the test results indicate significant wall thinning or corrosion but in no case shall the interval between direct examinations exceed once every ten years. If the tank has not undergone a direct internal inspection within the last 10 years, this option may only be used with prior written approval from the department.

3. Use of a robotic instrument to visually inspect the tank interior (i.e. bottom and shell) every five (5) years shall constitute a direct internal inspection. However, if the tank interior is visually and ultrasonically examined via a robot or an individual, the interval between direct internal inspections can be extended to ten (10) years. Depending on the substance stored, inspection without emptying the tank may or may not be an option.

Tanks that show signs of deterioration by any of the above tests must be taken out of service, emptied, cleaned, and repaired or retired. If the tank's interior bottom and shell cannot be adequately visualized or tested using any of the above methods, the tank must be emptied, cleaned, and visually internally inspected.

As allowed by N.J.A.C. 7:1E-1.11(e), if a facility can demonstrate to the satisfaction of the department that a particular method is appropriate to a tank's material of construction, size, and orientation and will adequately reveal the condition of the tank interior, this means of internal inspection will be considered acceptable upon evaluation and approval by the department.

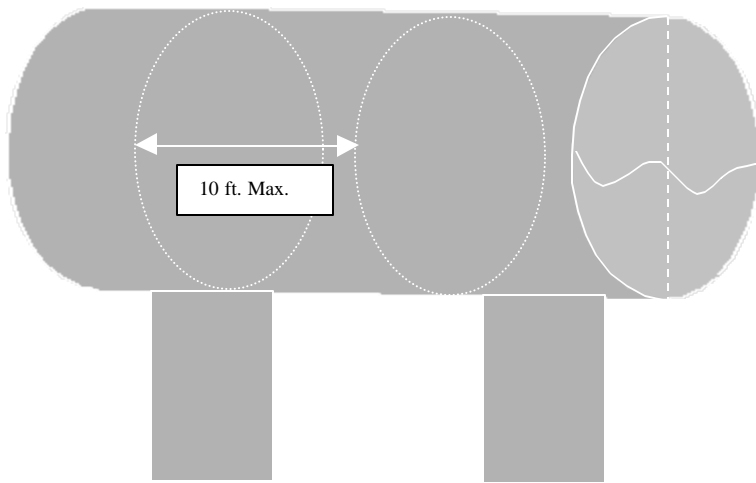


Figure 1

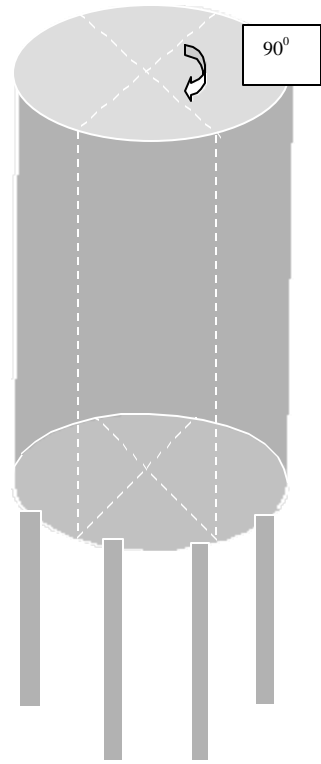


Figure 2

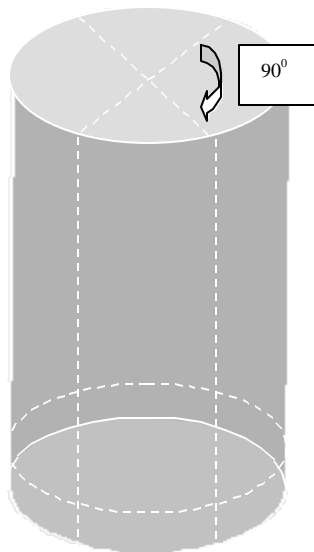


Figure 3

## **Alternative Testing Methods**

Since ultrasonic thickness testing is not a meaningful test for plastic tanks, the question frequently arises as to appropriate nondestructive testing techniques for plastic tanks. The bureau has found that acoustic emission tests are most often used by industry for testing fiberglass reinforced plastic (FRP) tanks. See ASTM Standard Practice E 1067 or Recommended Practice for Acoustic Emission Testing of FRP Resin Tanks/Vessels by the SPI's Composites Institute for more information. For homogenous plastic tanks internal Barcol hardness testing or a comprehensive external visual examination by a competent inspector knowledgeable of homogenous plastic tanks may be appropriate. Any alternative must be approved in advance by the bureau and clearly described in the facility's DPCC/DCR plan.

### **Fiberglass Reinforced Plastic (FRP) Tanks:**

1. ASTM E 1067 every five (5) years; **and**
2. Internal visual inspection conducted by a competent inspector knowledgeable of FRP tanks every five (5) years.

### **Homogenous Plastic Tanks:**

1. Static head test every five (5) years;
2. Internal Barcol hardness test **or** an external inspection conducted by a competent inspector knowledgeable of homogenous plastic tanks every five (5) years; **and**
3. Internal visual inspection conducted by a competent inspector knowledgeable of homogenous plastic tanks every five (5) years.

### **Pressure Vessels:**

Storage tanks constructed in accordance with ASME Section VIII or other recognized pressure vessel codes

may implement an inspection and maintenance program in accordance with API 510.

### **Shop Fabricated Tanks:**

Shop fabricated steel tanks built to a nationally recognized standard (e.g. UL 142 or UL 2085) that store noncorrosive, stable, flammable, and combustible liquids having a specific gravity less than or equal to that of water may implement an inspection program in accordance with the Steel Tank Institute (STI) standard SP001-00.

### **Elevated Multi-Compartment Tanks:**

Integrity testing shall be required only on those compartments of a multi-compartment tank that contain hazardous substances and are greater than 2,000 gallons. Therefore, a complete evaluation of the integrity of the tank shall consist of the following:

1. Static head testing of the required compartment every five (5) years;
2. Exterior UT measurements of the entire tank every five (5) years. UT measurements of the inner compartment wall need only be taken during internal visual inspections.
3. Internal visual inspection of the interior of the required compartment every ten (10) years. However, if adjoining compartments contain incompatible materials, then the internal visual inspection and UT measurements of the inner compartment wall must be conducted at least once every five (5) years.

## Informational Resources

Annual Book of ASTM Standards  
API Standards and Recommended Practices  
ASME Boiler and Pressure Vessel Code, Sections V and X  
*Chemical Engineering*  
*Chemical Engineering Progress*  
*Environmental Engineering World*  
Standard Handbook for Mechanical Engineers

American Chemical Society  
American Institute of Steel Tank Construction  
American Institute of Chemical Engineers  
American National Standards Institute  
American Petroleum Institute  
American Society of Mechanical Engineers  
The Composite Institute of the Society of the Plastics Industry  
National Association of Corrosion Engineers  
Steel Tank Institute  
Underwriters Laboratories